**Basic concepts of RAID**

---------------------------------

Chunk: - This is the size of data block used in RAID configuration. If chunk size is 64KB then there would be 16 chunks in 1MB (1024KB/64KB) RAID array.

Hot Spare: - This is the additional disk in RAID array. If any disk fails, data from faulty disk will be migrated in this spare disk automatically.

Mirroring: - If this feature is enabled, a copy of same data will be saved in other disk also. It is just like making an additional copy of data for backup purpose.

Striping: - If this feature is enabled, data will be written in all available disks randomly. It is just like sharing data between all disks, so all of them fill equally.

Parity: - This is method of regenerating lost data from saved parity information.

**RAID Level 0**

------------------

This level provides striping without parity. Since it does not store any parity data and perform read and write operation simultaneously, speed would be much faster than other level.

**This level requires at least two hard disks. All hard disks in this level are filled equally. You should use this level only if read and write speed are concerned**.

If you decide to use this level then always deploy alternative data backup plan. As any single disk failure from array will result in total data loss.

**RAID Level 1**

------------------

**This level provides parity without striping**.

It writes all data on two disks. If one disk is failed or removed, we still have all data on other disk.

This level requires double hard disks. It means if you want to use 2 hard disks then you have to deploy 4 hard disks or if you want use one hard disk then you have to deploy two hard disks.

First hard disk stores original data while other disk stores the exact copy of first disk.

Since data is written twice, performance will be reduced.

You should use this level only if data safety is concerned at any cost.

**RAID Level 5**

------------------

**This level provides both parity and striping. It requires at least three disks**.

It writes parity data equally in all disks. If one disk is failed, data can be reconstructed from parity data available on remaining disks.

This provides a combination of integrity and performance. Wherever possible you should always use this level.

How to configure software RAID step by step

-------------------------------------------

We have added disks of 2GB each for learning purpose.

OS: Redhat

VM Hosted in AWS

[root@vm1 ~]# lsblk

NAME MAJ:MIN RM SIZE RO TYPE MOUNTPOINTS

xvda 202:0 0 10G 0 disk

├─xvda1 202:1 0 1M 0 part

├─xvda2 202:2 0 200M 0 part /boot/efi

├─xvda3 202:3 0 1G 0 part /boot

└─xvda4 202:4 0 8.8G 0 part /

xvdb 202:16 0 2G 0 disk

xvdc 202:32 0 2G 0 disk

xvdd 202:48 0 2G 0 disk

[root@vm1 ~]#

## **mdadm package needed for working with OS RAID**

[root@vm1 ~]# rpm -qa | grep -i mdadm

mdadm-4.2-12.el9\_4.x86\_64

[root@vm1 ~]#

**Creating RAID 0 Array**

---------------------

We can create RAID 0 array with disks or partitions.

To understand both options we will create two separate RAID 0 arrays; one with disks and other with partitions.

RAID 0 Array requires at least two disks or partitions. We will use /dev/xvdc and /dev/xvdd disk to create RAID 0 Array from disks.

We will create two partitions in /dev/xvdb and later use them to create another RAID 0 Array from partitions.

#mdadm --create --verbose /dev/[ RAID array Name or Number] --level=[RAID Level] --raid-devices=[Number of storage devices] [Storage Device] [Storage Device]

[root@vm1 ~]# **mdadm --create --verbose /dev/md0 --level=0 --raid-devices=2 /dev/xvdc /dev/xvdd**

mdadm: chunk size defaults to 512K

mdadm: Defaulting to version 1.2 metadata

mdadm: array /dev/md0 started.

[root@vm1 ~]#

[root@vm1 ~]# cat /proc/mdstat

Personalities : [raid0]

md0 : active raid0 xvdd[1] xvdc[0]

4188160 blocks super 1.2 512k chunks

unused devices: <none>

[root@vm1 ~]#

**Creating RAID 0 Array with partitions**

--------------------------------------

[root@vm1 ~]# **fdisk /dev/xvdb** ## Creating partition from fdisk

Welcome to fdisk (util-linux 2.37.4).

Changes will remain in memory only, until you decide to write them.

Be careful before using the write command.

Device does not contain a recognized partition table.

Created a new DOS disklabel with disk identifier 0xe61531fd.

Command (m for help): n ## To create a partition

Partition type

p primary (0 primary, 0 extended, 4 free)

e extended (container for logical partitions)

Select (default p): p ## Creating Primary Partition

Partition number (1-4, default 1): 1

First sector (2048-4194303, default 2048):

Last sector, +/-sectors or +/-size{K,M,G,T,P} (2048-4194303, default 4194303): +1G

Created a new partition 1 of type 'Linux' and of size 1 GiB.

Command (m for help): p ## print

Disk /dev/xvdb: 2 GiB, 2147483648 bytes, 4194304 sectors

Units: sectors of 1 \* 512 = 512 bytes

Sector size (logical/physical): 512 bytes / 512 bytes

I/O size (minimum/optimal): 512 bytes / 512 bytes

Disklabel type: dos

Disk identifier: 0xe61531fd

Device Boot Start End Sectors Size Id Type

/dev/xvdb1 2048 2099199 2097152 1G 83 Linux

Command (m for help): l ## to list partition type

00 Empty 24 NEC DOS 81 Minix / old Lin bf Solaris

01 FAT12 27 Hidden NTFS Win 82 Linux swap / So c1 DRDOS/sec (FAT-

02 XENIX root 39 Plan 9 83 Linux c4 DRDOS/sec (FAT-

03 XENIX usr 3c PartitionMagic 84 OS/2 hidden or c6 DRDOS/sec (FAT-

04 FAT16 <32M 40 Venix 80286 85 Linux extended c7 Syrinx

05 Extended 41 PPC PReP Boot 86 NTFS volume set da Non-FS data

06 FAT16 42 SFS 87 NTFS volume set db CP/M / CTOS / .

07 HPFS/NTFS/exFAT 4d QNX4.x 88 Linux plaintext de Dell Utility

08 AIX 4e QNX4.x 2nd part 8e Linux LVM df BootIt

09 AIX bootable 4f QNX4.x 3rd part 93 Amoeba e1 DOS access

0a OS/2 Boot Manag 50 OnTrack DM 94 Amoeba BBT e3 DOS R/O

0b W95 FAT32 51 OnTrack DM6 Aux 9f BSD/OS e4 SpeedStor

0c W95 FAT32 (LBA) 52 CP/M a0 IBM Thinkpad hi ea Linux extended

0e W95 FAT16 (LBA) 53 OnTrack DM6 Aux a5 FreeBSD eb BeOS fs

0f W95 Ext'd (LBA) 54 OnTrackDM6 a6 OpenBSD ee GPT

10 OPUS 55 EZ-Drive a7 NeXTSTEP ef EFI (FAT-12/16/

11 Hidden FAT12 56 Golden Bow a8 Darwin UFS f0 Linux/PA-RISC b

12 Compaq diagnost 5c Priam Edisk a9 NetBSD f1 SpeedStor

14 Hidden FAT16 <3 61 SpeedStor ab Darwin boot f4 SpeedStor

16 Hidden FAT16 63 GNU HURD or Sys af HFS / HFS+ f2 DOS secondary

17 Hidden HPFS/NTF 64 Novell Netware b7 BSDI fs fb VMware VMFS

18 AST SmartSleep 65 Novell Netware b8 BSDI swap fc VMware VMKCORE

1b Hidden W95 FAT3 70 DiskSecure Mult bb Boot Wizard hid fd Linux raid auto

1c Hidden W95 FAT3 75 PC/IX bc Acronis FAT32 L fe LANstep

1e Hidden W95 FAT1 80 Old Minix be Solaris boot ff BBT

Aliases:

linux - 83

swap - 82

extended - 05

uefi - EF

raid - FD

lvm - 8E

linuxex - 85

Command (m for help): t ## to change the

Selected partition 1

**Hex code or alias (type L to list all): fd ## Linux raid auto**

Changed type of partition 'Linux' to 'Linux raid autodetect'.

Command (m for help): w # To save and exit

The partition table has been altered.

Calling ioctl() to re-read partition table.

Syncing disks.

[root@vm1 ~]# **partprobe ##update run time kernel**

[root@vm1 ~]#

[root@vm1 ~]# **parted /dev/xvdb** ## Creating partition from parted

GNU Parted 3.5

Using /dev/xvdb

Welcome to GNU Parted! Type 'help' to view a list of commands.

(parted) print

Model: Xen Virtual Block Device (xvd)

Disk /dev/xvdb: 2147MB

Sector size (logical/physical): 512B/512B

Partition Table: msdos

Disk Flags:

Number Start End Size Type File system Flags

1 1049kB 1075MB 1074MB primary raid

(parted) mkpart

Partition type? primary/extended? primary

File system type? [ext2]?

Start? 1076

End? 2100

End? 3000

(parted) print

Model: Xen Virtual Block Device (xvd)

Disk /dev/xvdb: 2147MB

Sector size (logical/physical): 512B/512B

Partition Table: msdos

Disk Flags:

Number Start End Size Type File system Flags

1 1049kB 1075MB 1074MB primary raid

2 1076MB 2100MB 1024MB primary ext2

(parted) quit

Information: You may need to update /etc/fstab.

[root@vm1 ~]# **partprobe**

[root@vm1 ~]#

[root@vm1 ~]# lsblk

NAME MAJ:MIN RM SIZE RO TYPE MOUNTPOINTS

xvda 202:0 0 10G 0 disk

├─xvda1 202:1 0 1M 0 part

├─xvda2 202:2 0 200M 0 part /boot/efi

├─xvda3 202:3 0 1G 0 part /boot

└─xvda4 202:4 0 8.8G 0 part /

xvdb 202:16 0 2G 0 disk

├─xvdb1 202:17 0 1G 0 part

└─xvdb2 202:18 0 977M 0 part

xvdc 202:32 0 2G 0 disk

└─md0 9:0 0 4G 0 raid0

xvdd 202:48 0 2G 0 disk

└─md0 9:0 0 4G 0 raid0

[root@vm1 ~]#

[root@vm1 ~]# **mdadm --create --verbose /dev/md1 --level=0 --raid-devices=2 /dev/xvdb1 /dev/xvdb2**

mdadm: chunk size defaults to 512K

mdadm: Defaulting to version 1.2 metadata

mdadm: array /dev/md1 started.

[root@vm1 ~]#

When we use mdadm command to create a new RAID array, it puts its signature on provided device or partition.

It means we can create RAID array from any partition type or even from a disk which does not contain any partition at all.

So which partition type we use here is not important, the important point which we should always consider is that partition should not contain any valuable data.

During this process all data from partition will be wiped out.

**Creating File system in RAID Array**

--------------------------------------------

#mkfs –t [File system type] [RAID Device]

[root@vm1 ~]# **mkfs -t ext4 /dev/md0 ## Creating ext4 FS**

mke2fs 1.46.5 (30-Dec-2021)

Creating filesystem with 1047040 4k blocks and 262144 inodes

Filesystem UUID: 843d928d-8c28-4160-aa21-f19646ce04f8

Superblock backups stored on blocks:

32768, 98304, 163840, 229376, 294912, 819200, 884736

Allocating group tables: done

Writing inode tables: done

Creating journal (16384 blocks): done

Writing superblocks and filesystem accounting information: done

[root@vm1 ~]# **mkfs -t xfs /dev/md1 ## Creating XFS FS**

log stripe unit (524288 bytes) is too large (maximum is 256KiB)

log stripe unit adjusted to 32KiB

meta-data=/dev/md1 isize=512 agcount=8, agsize=63872 blks

= sectsz=512 attr=2, projid32bit=1

= crc=1 finobt=1, sparse=1, rmapbt=0

= reflink=1 bigtime=1 inobtcount=1 nrext64=0

data = bsize=4096 blocks=510976, imaxpct=25

= sunit=128 swidth=256 blks

naming =version 2 bsize=4096 ascii-ci=0, ftype=1

log =internal log bsize=4096 blocks=16384, version=2

= sectsz=512 sunit=8 blks, lazy-count=1

realtime =none extsz=4096 blocks=0, rtextents=0

[root@vm1 ~]#

**Temporary mounting RAID 0 Array**

--------------------------------------------

[root@vm1 ~]# mkdir /mount

[root@vm1 ~]# **mount /dev/md0 /mount**

[root@vm1 ~]# ls /mount

lost+found

[root@vm1 ~]# mkdir /mount/md0-test-dir

[root@vm1 ~]# touch /mount/md0-test-file

[root@vm1 ~]# ls /mount

lost+found md0-test-dir md0-test-file

[root@vm1 ~]# **umount /mount**

[root@vm1 ~]# **mount /dev/md1 /mount**

[root@vm1 ~]# ls /mount

[root@vm1 ~]# mkdir /mount/md1-test-dir

[root@vm1 ~]# touch /mount/md1-test-file

[root@vm1 ~]# ls /mount

md1-test-dir md1-test-file

[root@vm1 ~]# **umount /mount**

[root@vm1 ~]# ls /mount

[root@vm1 ~]#

**Mounting RAID Array permanently**

-------------------------------------------

[root@vm1 ~]# blkid /dev/md0

/dev/md0: UUID="843d928d-8c28-4160-aa21-f19646ce04f8" TYPE="ext4"

[root@vm1 ~]# mount UUID="843d928d-8c28-4160-aa21-f19646ce04f8" /mount

[root@vm1 ~]# ls /mount

lost+found md0-test-dir md0-test-file

[root@vm1 ~]#

[root@vm1 ~]# blkid /dev/md1

/dev/md1: UUID="d97d2ffa-8fee-4a0b-ae1d-9625c3d316da" TYPE="xfs"

[root@vm1 ~]# mount UUID="d97d2ffa-8fee-4a0b-ae1d-9625c3d316da" /mount

[root@vm1 ~]# ls /mount

md1-test-dir md1-test-file

[root@vm1 ~]# umount /mount

[root@vm1 ~]#

[root@vm1 ~]# mkdir /app1

[root@vm1 ~]# mkdir /app2

[root@vm1 ~]# cat /etc/fstab | tail -2

**UUID=843d928d-8c28-4160-aa21-f19646ce04f8 /app1 ext4 defaults 0 0**

**UUID=d97d2ffa-8fee-4a0b-ae1d-9625c3d316da /app2 xfs defaults 0 0**

[root@vm1 ~]# mount -a

mount: (hint) your fstab has been modified, but systemd still uses

the old version; use 'systemctl daemon-reload' to reload.

[root@vm1 ~]# systemctl daemon-reload

[root@vm1 ~]# mount -a

[root@vm1 ~]#

[root@vm1 ~]# df -TPh /app\*

Filesystem Type Size Used Avail Use% Mounted on

/dev/md0 ext4 3.9G 28K 3.7G 1% /app1

/dev/md1 xfs 1.9G 46M 1.9G 3% /app2

[root@vm1 ~]#

**Delete RAID**

----------------------

**[root@vm1 ~]# umount /app1**

**[root@vm1 ~]# umount /app2**

[root@vm1 ~]# cat /proc/mdstat

Personalities : [raid0]

md1 : active raid0 xvdb2[1] xvdb1[0]

2044928 blocks super 1.2 512k chunks

md0 : active raid0 xvdd[1] xvdc[0]

4188160 blocks super 1.2 512k chunks

unused devices: <none>

[root@vm1 ~]# mdadm --stop /dev/md0 ## To stop the RAID Array

mdadm: stopped /dev/md0

[root@vm1 ~]# mdadm --stop /dev/md1 ## To stop the RAID Array

mdadm: stopped /dev/md1

[root@vm1 ~]# cat /proc/mdstat

Personalities : [raid0]

unused devices: <none>

[root@vm1 ~]# cp -p /etc/fstab.bkp /etc/fstab ## Remove the entries related to RAID

**[root@vm1 ~]# dd if=/dev/zero of=/dev/xvdb bs=1M ## Wipe the disk**

dd: error writing '/dev/xvdb': No space left on device

2049+0 records in

2048+0 records out

2147483648 bytes (2.1 GB, 2.0 GiB) copied, 32.6589 s, 65.8 MB/s

[root@vm1 ~]# **dd if=/dev/zero of=/dev/xvdc bs=1M ## Wipe the disk**

dd: error writing '/dev/xvdc': No space left on device

2049+0 records in

2048+0 records out

2147483648 bytes (2.1 GB, 2.0 GiB) copied, 32.6641 s, 65.7 MB/s

[root@vm1 ~]# dd if=/dev/zero of=/dev/xvdd bs=1M ## Wipe the disk

dd: error writing '/dev/xvdd': No space left on device

2049+0 records in

2048+0 records out

2147483648 bytes (2.1 GB, 2.0 GiB) copied, 32.6568 s, 65.8 MB/s

[root@vm1 ~]#

**How to create RAID 1 and RAID 5 array**

--------------------------------------------------

[root@vm1 ~]# **mdadm --create --verbose /dev/md0 --level=1 --raid-devices=2 /dev/xvdc /dev/xvdd ## RAID 1**

mdadm: Note: this array has metadata at the start and

may not be suitable as a boot device. If you plan to

store '/boot' on this device please ensure that

your boot-loader understands md/v1.x metadata, or use

--metadata=0.90

mdadm: size set to 2094080K

Continue creating array? y

mdadm: Defaulting to version 1.2 metadata

mdadm: array /dev/md0 started.

[root@vm1 ~]#

[root@vm1 ~]# mdadm --stop /dev/md0

[root@vm1 ~]# cat /proc/mdstat

Personalities : [raid0] [raid1]

unused devices: <none>

[root@vm1 ~]#

[root@vm1 ~]# dd if=/dev/zero of=/dev/xvdc bs=1M

dd: error writing '/dev/xvdc': No space left on device

2049+0 records in

2048+0 records out

2147483648 bytes (2.1 GB, 2.0 GiB) copied, 32.6584 s, 65.8 MB/s

[root@vm1 ~]# dd if=/dev/zero of=/dev/xvdd bs=1M

dd: error writing '/dev/xvdd': No space left on device

2049+0 records in

2048+0 records out

2147483648 bytes (2.1 GB, 2.0 GiB) copied, 32.6579 s, 65.8 MB/s

[root@vm1 ~]#

[root@vm1 ~]# **mdadm --create --verbose /dev/md0 --level=5 --raid-devices=3 /dev/xvdb /dev/xvdc /dev/xvdd** ##RAID 5

mdadm: layout defaults to left-symmetric

mdadm: layout defaults to left-symmetric

mdadm: chunk size defaults to 512K

mdadm: size set to 2094080K

mdadm: Defaulting to version 1.2 metadata

mdadm: array /dev/md0 started.

[root@vm1 ~]# cat /proc/mdstat

Personalities : [raid0] [raid1] [raid6] [raid5] [raid4]

md0 : active raid5 xvdd[3] xvdc[1] xvdb[0]

4188160 blocks super 1.2 level 5, 512k chunk, algorithm 2 [3/2] [UU\_]

[====>................] recovery = 23.3% (489044/2094080) finish=0.7min speed=34931K/sec

unused devices: <none>

[root@vm1 ~]# cat /proc/mdstat

Personalities : [raid0] [raid1] [raid6] [raid5] [raid4]

md0 : active raid5 xvdd[3] xvdc[1] xvdb[0]

4188160 blocks super 1.2 level 5, 512k chunk, algorithm 2 [3/3] [UUU]

unused devices: <none>

[root@vm1 ~]#

[root@vm1 ~]# **mkfs -t xfs /dev/md0 ## Creating XFS FS**

log stripe unit (524288 bytes) is too large (maximum is 256KiB)

log stripe unit adjusted to 32KiB

meta-data=/dev/md0 isize=512 agcount=8, agsize=130944 blks

= sectsz=512 attr=2, projid32bit=1

= crc=1 finobt=1, sparse=1, rmapbt=0

= reflink=1 bigtime=1 inobtcount=1 nrext64=0

data = bsize=4096 blocks=1047040, imaxpct=25

= sunit=128 swidth=256 blks

naming =version 2 bsize=4096 ascii-ci=0, ftype=1

log =internal log bsize=4096 blocks=16384, version=2

= sectsz=512 sunit=8 blks, lazy-count=1

realtime =none extsz=4096 blocks=0, rtextents=0

[root@vm1 ~]#

[root@vm1 ~]# mount /dev/md0 /app1

[root@vm1 ~]#

[root@vm1 ~]# df -h /app1

Filesystem Size Used Avail Use% Mounted on

/dev/md0 4.0G 61M 3.9G 2% /app1

[root@vm1 ~]#

[root@vm1 ~]# dd if=/dev/urandom of=/app1/file1 bs=1M count=100

100+0 records in

100+0 records out

104857600 bytes (105 MB, 100 MiB) copied, 0.418164 s, 251 MB/s

[root@vm1 ~]# du -sh /app1/file1

100M /app1/file1

[root@vm1 ~]#

**How to view the detail of RAID device**

-------------------------------------

[root@vm1 ~]# **mdadm --detail /dev/md0**

/dev/md0:

Version : 1.2

Creation Time : Thu Jul 25 13:05:19 2024

Raid Level : raid5

Array Size : 4188160 (3.99 GiB 4.29 GB)

Used Dev Size : 2094080 (2045.00 MiB 2144.34 MB)

Raid Devices : 3

Total Devices : 3

Persistence : Superblock is persistent

Update Time : Thu Jul 25 13:13:53 2024

State : clean

Active Devices : 3

Working Devices : 3

Failed Devices : 0

Spare Devices : 0

Layout : left-symmetric

Chunk Size : 512K

Consistency Policy : resync

Name : vm1:0 (local to host vm1)

UUID : 2cca37dc:90d238a3:c62adb9d:43ef768d

Events : 18

Number Major Minor RaidDevice State

0 202 16 0 active sync /dev/xvdb

1 202 32 1 active sync /dev/xvdc

3 202 48 2 active sync /dev/xvdd

[root@vm1 ~]#

**How to add additional disk or partition in RAID**

-----------------------------------------------

Check whether the disk is part of mdadm or not

[root@vm1 ~]# **mdadm --examine /dev/xvde**

mdadm: No md superblock detected on /dev/xvde.

[root@vm1 ~]#

[root@vm1 ~]# **mdadm --examine /dev/xvdd**

/dev/xvdd:

Magic : a92b4efc

Version : 1.2

Feature Map : 0x0

Array UUID : 2cca37dc:90d238a3:c62adb9d:43ef768d

Name : vm1:0 (local to host vm1)

Creation Time : Thu Jul 25 13:05:19 2024

**Raid Level : raid5**

**Raid Devices : 3**

Avail Dev Size : 4188160 sectors (2045.00 MiB 2144.34 MB)

Array Size : 4188160 KiB (3.99 GiB 4.29 GB)

Data Offset : 6144 sectors

Super Offset : 8 sectors

Unused Space : before=6064 sectors, after=0 sectors

State : clean

Device UUID : 9a7dfe39:6a37eed3:239a79dc:8c80341c

Update Time : Thu Jul 25 13:14:23 2024

Bad Block Log : 512 entries available at offset 16 sectors

Checksum : 628acd15 - correct

Events : 18

Layout : left-symmetric

Chunk Size : 512K

Device Role : Active device 2

Array State : AAA ('A' == active, '.' == missing, 'R' == replacing)

[root@vm1 ~]#

[root@vm1 ~]# **mdadm --manage /dev/md0 --add /dev/xvde ## Additional disk or spare disk is added**

mdadm: added /dev/xvde

[root@vm1 ~]# cat /proc/mdstat

Personalities : [raid0] [raid1] [raid6] [raid5] [raid4]

md0 : active raid5 xvde[4](S) xvdd[3] xvdc[1] xvdb[0]

4188160 blocks super 1.2 level 5, 512k chunk, algorithm 2 [3/3] [UUU]

unused devices: <none>

[root@vm1 ~]#

[root@vm1 ~]# **mdadm --detail /dev/md0**

/dev/md0:

Version : 1.2

Creation Time : Thu Jul 25 13:05:19 2024

Raid Level : raid5

Array Size : 4188160 (3.99 GiB 4.29 GB)

Used Dev Size : 2094080 (2045.00 MiB 2144.34 MB)

Raid Devices : 3

Total Devices : 4

Persistence : Superblock is persistent

Update Time : Thu Jul 25 13:25:37 2024

State : clean

**Active Devices : 3**

**Working Devices : 4**

Failed Devices : 0

Spare Devices : 1

Layout : left-symmetric

Chunk Size : 512K

Consistency Policy : resync

Name : vm1:0 (local to host vm1)

UUID : 2cca37dc:90d238a3:c62adb9d:43ef768d

Events : 19

Number Major Minor RaidDevice State

0 202 16 0 active sync /dev/xvdb

1 202 32 1 active sync /dev/xvdc

3 202 48 2 active sync /dev/xvdd

**4 202 64 - spare /dev/xvde ### Spare disk showing**

[root@vm1 ~]#

**If any disk fails and spare disks are available, RAID will automatically select the first available spare disk to replace the faulty disk.**

**Spare disks are the best backup plan in RAID device.**

**Increase the size of array. Following command is used to grow the size of RAID device.**

------------------------------------------------------------------------------------------------------------

[root@vm1 ~]# **mdadm --grow --raid-devices=4 /dev/md0 ### To use the spare disk now in the raid**

[root@vm1 ~]# **mdadm --detail /dev/md0**

/dev/md0:

Version : 1.2

Creation Time : Thu Jul 25 13:05:19 2024

Raid Level : raid5

Array Size : 4188160 (3.99 GiB 4.29 GB)

Used Dev Size : 2094080 (2045.00 MiB 2144.34 MB)

Raid Devices : 4

Total Devices : 4

Persistence : Superblock is persistent

Update Time : Thu Jul 25 13:30:15 2024

State : clean, reshaping

**Active Devices : 4**

**Working Devices : 4**

Failed Devices : 0

Spare Devices : 0

Layout : left-symmetric

Chunk Size : 512K

Consistency Policy : resync

Reshape Status : 7% complete ## It will sync

Delta Devices : 1, (3->4)

Name : vm1:0 (local to host vm1)

UUID : 2cca37dc:90d238a3:c62adb9d:43ef768d

Events : 36

Number Major Minor RaidDevice State

0 202 16 0 active sync /dev/xvdb

1 202 32 1 active sync /dev/xvdc

3 202 48 2 active sync /dev/xvdd

4 202 64 3 active sync /dev/xvde

**Removing faulty device**

------------------------------------

If spare device is available, RAID will automatically replace the faulty device with spare device. End user will not see any change. He will be able to access the data as usual. Let’s understand it practically.

Now we dont have any spare device so lets add the spare device and check.

[root@vm1 ~]# **mdadm --detail /dev/md0**

/dev/md0:

Version : 1.2

Creation Time : Thu Jul 25 13:05:19 2024

Raid Level : raid5

Array Size : 6282240 (5.99 GiB 6.43 GB)

Used Dev Size : 2094080 (2045.00 MiB 2144.34 MB)

Raid Devices : 4

Total Devices : 4

Persistence : Superblock is persistent

Update Time : Thu Jul 25 13:32:27 2024

State : clean

Active Devices : 4

Working Devices : 4

Failed Devices : 0

Spare Devices : 0

Layout : left-symmetric

Chunk Size : 512K

Consistency Policy : resync

Name : vm1:0 (local to host vm1)

UUID : 2cca37dc:90d238a3:c62adb9d:43ef768d

Events : 51

Number Major Minor RaidDevice State

0 202 16 0 active sync /dev/xvdb

1 202 32 1 active sync /dev/xvdc

3 202 48 2 active sync /dev/xvdd

4 202 64 3 active sync /dev/xvde

[root@vm1 ~]#

[root@vm1 ~]# **mdadm --manage /dev/md0 --add /dev/xvdf**

mdadm: added /dev/xvdf

[root@vm1 ~]#

[root@vm1 ~]# cat /proc/mdstat

Personalities : [raid0] [raid1] [raid6] [raid5] [raid4]

md0 : active raid5 xvdf[5](S) xvde[4] xvdd[3] xvdc[1] xvdb[0]

6282240 blocks super 1.2 level 5, 512k chunk, algorithm 2 [4/4] [UUUU]

unused devices: <none>

[root@vm1 ~]# **mdadm --detail /dev/md0**

/dev/md0:

Version : 1.2

Creation Time : Thu Jul 25 13:05:19 2024

Raid Level : raid5

Array Size : 6282240 (5.99 GiB 6.43 GB)

Used Dev Size : 2094080 (2045.00 MiB 2144.34 MB)

Raid Devices : 4

Total Devices : 5

Persistence : Superblock is persistent

Update Time : Thu Jul 25 13:46:32 2024

State : clean

Active Devices : 4

Working Devices : 5

Failed Devices : 0

Spare Devices : 1

Layout : left-symmetric

Chunk Size : 512K

Consistency Policy : resync

Name : vm1:0 (local to host vm1)

UUID : 2cca37dc:90d238a3:c62adb9d:43ef768d

Events : 52

Number Major Minor RaidDevice State

0 202 16 0 active sync /dev/xvdb

1 202 32 1 active sync /dev/xvdc

3 202 48 2 active sync /dev/xvdd

4 202 64 3 active sync /dev/xvde

5 202 80 - spare /dev/xvdf ### We have a spare device

[root@vm1 ~]#

**To mark a disk as failed device following command is used.**

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

In Production normally the disk will be faulty and we need to replace the disk

[root@vm1 ~]# ls /app1

file1

[root@vm1 ~]#

[root@vm1 ~]# **mdadm --manage --set-faulty /dev/md0 /dev/xvdc**

mdadm: set /dev/xvdc faulty in /dev/md0

[root@vm1 ~]#

[root@vm1 ~]# ls /app1

file1

[root@vm1 ~]#

[root@vm1 ~]# **mdadm --detail /dev/md0**

/dev/md0:

Version : 1.2

Creation Time : Thu Jul 25 13:05:19 2024

Raid Level : raid5

Array Size : 6282240 (5.99 GiB 6.43 GB)

Used Dev Size : 2094080 (2045.00 MiB 2144.34 MB)

**Raid Devices : 4**

**Total Devices : 5**

Persistence : Superblock is persistent

Update Time : Thu Jul 25 13:49:48 2024

**State : clean, degraded, recovering**

Active Devices : 3

Working Devices : 4

Failed Devices : 1

Spare Devices : 1

Layout : left-symmetric

Chunk Size : 512K

Consistency Policy : resync

Rebuild Status : 23% complete

Name : vm1:0 (local to host vm1)

UUID : 2cca37dc:90d238a3:c62adb9d:43ef768d

Events : 57

Number Major Minor RaidDevice State

0 202 16 0 active sync /dev/xvdb

5 202 80 1 spare rebuilding /dev/xvdf ## Spare device started rebuilding

3 202 48 2 active sync /dev/xvdd

4 202 64 3 active sync /dev/xvde

1 202 32 - faulty /dev/xvdc

[root@vm1 ~]#

[root@vm1 ~]# **mdadm --manage /dev/md0 --remove /dev/xvdc**

mdadm: hot removed /dev/xvdc from /dev/md0

[root@vm1 ~]# mdadm --detail /dev/md0

/dev/md0:

Version : 1.2

Creation Time : Thu Jul 25 13:05:19 2024

Raid Level : raid5

Array Size : 6282240 (5.99 GiB 6.43 GB)

Used Dev Size : 2094080 (2045.00 MiB 2144.34 MB)

Raid Devices : 4

Total Devices : 4

Persistence : Superblock is persistent

Update Time : Thu Jul 25 14:20:25 2024

State : clean

Active Devices : 4

Working Devices : 4

Failed Devices : 0

Spare Devices : 0

Layout : left-symmetric

Chunk Size : 512K

Consistency Policy : resync

Name : vm1:0 (local to host vm1)

UUID : 2cca37dc:90d238a3:c62adb9d:43ef768d

Events : 72

Number Major Minor RaidDevice State

0 202 16 0 active sync /dev/xvdb

5 202 80 1 active sync /dev/xvdf

3 202 48 2 active sync /dev/xvdd

4 202 64 3 active sync /dev/xvde

[root@vm1 ~]#

[root@vm1 **~]# cat /proc/mdstat**

Personalities : [raid0] [raid1] [raid6] [raid5] [raid4]

md0 : active raid5 xvdf[5] xvde[4] xvdd[3] xvdc[1](F) xvdb[0]

6282240 blocks super 1.2 level 5, 512k chunk, algorithm 2 [4/3] [U\_UU]

[===============>.....] recovery = 75.9% (1590448/2094080) finish=0.3min speed=21070K/sec

unused devices: <none>

[root@vm1 ~]#

[root@vm1 ~]# cat /proc/mdstat

Personalities : [raid0] [raid1] [raid6] [raid5] [raid4]

md0 : active raid5 xvdf[5] xvde[4] xvdd[3] xvdc[1](F) xvdb[0]

6282240 blocks super 1.2 level 5, 512k chunk, algorithm 2 [4/4] [UUUU]

unused devices: <none>

[root@vm1 ~]#

Now suppose the new disk is added we can add it back assuming the whole disk was added in raid

[root@vm1 ~]# **mdadm --manage /dev/md0 --add /dev/xvdc**

[root@vm1 ~]# **mdadm --detail /dev/md0**

/dev/md0:

Version : 1.2

Creation Time : Thu Jul 25 13:05:19 2024

Raid Level : raid5

Array Size : 6282240 (5.99 GiB 6.43 GB)

Used Dev Size : 2094080 (2045.00 MiB 2144.34 MB)

Raid Devices : 4

Total Devices : 5

Persistence : Superblock is persistent

Update Time : Thu Jul 25 14:24:31 2024

State : clean

Active Devices : 4

Working Devices : 5

Failed Devices : 0

Spare Devices : 1

Layout : left-symmetric

Chunk Size : 512K

Consistency Policy : resync

Name : vm1:0 (local to host vm1)

UUID : 2cca37dc:90d238a3:c62adb9d:43ef768d

Events : 73

Number Major Minor RaidDevice State

0 202 16 0 active sync /dev/xvdb

5 202 80 1 active sync /dev/xvdf

3 202 48 2 active sync /dev/xvdd

4 202 64 3 active sync /dev/xvde

6 202 32 - spare /dev/xvdc

[root@vm1 ~]#

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*